390129

FLOOD INSURANCE STUDY

CITY OF SHAKER HEIGHTS, OHIO

CUYAHOGA COUNTY

DECEMBER 15, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 390129

FEM 1.209:

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PUBLISHED SEPARATELY:

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FLOOD INSURANCE STUDY

CITY OF SHAKER HEIGHTS,
CUYAHOGA COUNTY, OHIO

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Shaker Heights, Cuyahoga County, Ohio, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the City of Shaker Heights to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.1 (c). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Burgess & Niple, Limited, for the Federal Insurance Administration, under Contract No. H-4717. Approximate flood boundaries for some streams in the City of Shaker Heights were initially determined in August 1975 by Gannett, Fleming, Corddry, and Carpenter under contract to the Federal Insurance Administration. This study was completed in March 1980.

1.3 Coordination

The Consultation Coordination Officer, appointed by the FIA, organized the first community meeting held on March 23, 1978. This meeting, attended by representatives of the City of Shaker Heights, the FIA, the Study Contractor, and the Ohio Department of Natural Resources (ODNR), was held to explain the nature and purpose of the Flood Insurance Study. Upon

the initiation of the study, a news release was placed in the Cleveland Plain Dealer on May 17, 1979, and the Sun Press on May 17, 1979, to state the study objectives and to notify all interested persons to submit any relevant facts and technical data concerning local flood hazards.

Highway bridge information was received from the Cuyahoga County Engineer and the Ohio Department of Transportation. Results of the hydrologic analyses were coordinated with the City of Shaker Heights; the U.S. Geological Survey (USGS); the U.S. Department of Agriculture, Soil Conservation Service (SCS); the U.S. Army Corps of Engineers (COE), Buffalo District; and the ODNR. The ODNR served as the state coordinating agency for this study.

An intermediate coordination meeting was held at Shaker Heights on February 22, 1980. The purpose of this meeting was to review this Flood Insurance Study's flood boundaries as prepared by the Study Contractor with the Service Director, City Engineer, and Law Director of Shaker Heights, and to obtain information on flooding of Kingsbury Run and Tributary 2 of Kingsbury Run. No changes were made as a result of this meeting.

On July 30, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, the FIA, and the ODNR, and community officials.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Shaker Heights, Cuyahoga County, Ohio. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through March 1985.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the FIA and the City of Shaker Heights.

Floods caused by overflow of Doan Brook from the west corporate limit to 4,500 feet upstream of Torrington Road was studied in detail, but no floodway analysis was performed since no further development is being planned for the flood plain. Flooding on Kingsbury Run, Tributary 2 of Kingsbury Run, and Tributaries 1 and 1A of Doan Brook were studied by approximate methods.

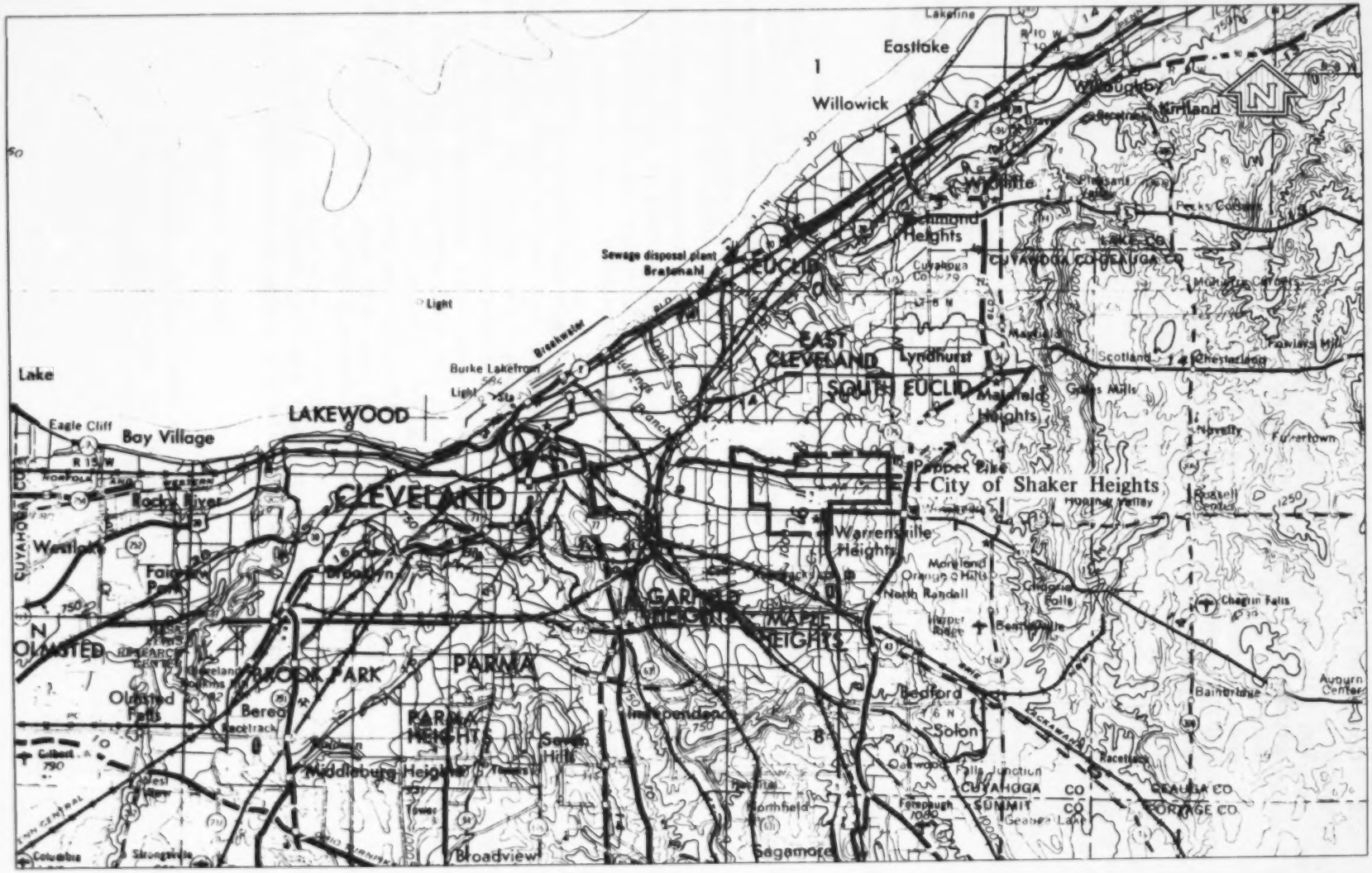

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF SHAKER HEIGHTS, OH
(CUYAHOGA CO.)

APPROXIMATE SCALE
4 0 4 8 12 MILES

VICINITY MAP

2.2 Community Description

The City of Shaker Heights is in east-central Cuyahoga County in northeastern Ohio, approximately six miles east of downtown Cleveland. A residential suburb, Shaker Heights covers approximately 6.5 square miles, and is bordered by Beachwood to the east and northeast, University Heights and Cleveland Heights to the north, Cleveland to the west and south, and Warrensville Heights and the Township of Warrensville to the southeast. The population of the community is 36,306 persons (1970 census), a decrease of 154 from the 1960 census (Reference 1). The economy of the community is basically residential, with some retail and small business establishments. Business and industrial activities in Cleveland and neighboring communities support a large segment of Shaker Heights' working community.

The climate of Shaker Heights is mainly continental in character, but experiences strong modifying influences from Lake Erie. The temperature ranges from an average monthly high of 71.4 degrees Fahrenheit (F.) in July to a low of 26.9 degrees F. in January, with an average yearly temperature of 49.7 degrees F. (Reference 2). The mean annual precipitation is 34.99 inches with an average recorded snowfall of 46 inches per year (Reference 3). The precipitation is uniformly distributed throughout the year.

The soils in this region formed on low glacial drift of Wisconsin age and were derived mainly from sandstone, shale, and low amounts of limestone. The predominant soil types of the area fall into the Mahoning-Ellsworth Association, which is typified by gently undulating, rolling upland areas. The Mahoning soils generally exhibit poor drainage characteristics while the Ellsworth soils are moderately well-drained (Reference 4). Forest vegetation for the region is of the oak-hickory variety. The considerable variation in topography and soils discouraged agricultural development but provided an attractive climate for the development of a variety of plant growth in those areas not absorbed by urbanization.

The major watercourses in the community include Doan Brook, flowing in a northwesterly direction through the northern half of Shaker Heights and Tributaries 1 and 1A of Doan Brook. The size of the drainage basin affecting the community at the downstream study limit of Doan Brook is 5.1 square miles. Development along Doan Brook predominately consists of parkland in the lower portion of the study reach, and residential and recreational development along the upper portion. Development along Tributaries 1 and 1A is primarily park and recreational in nature. Kingsbury Run and Tributary 2 of Kingsbury Run, once open watercourses and now enclosed, serve the lower portion of Shaker Heights.

There is little development within the flood plain of Doan Brook due to current land use regulations. The area within the flood plain is primarily parkland for recreational use.

2.3 Principal Flood Problems

The history of flooding on the streams within the City of Shaker Heights indicates that flooding may occur during any season of the year. Major floods generally occur in winter or early spring and may be worsened if the rain is accompanied by melting snow.

The effects of past flooding is illustrated in Figure 2 which shows the flooding resulting from a thunderstorm on Sunday, August 24, 1975. The storm reportedly deluged Shaker Heights with six inches of rain in less than three hours. This has a rainfall frequency greater than 100 years, based on the rainfall frequency data for the Cleveland area (Reference 5). This, together with continuing rain through the week and several additional inches of rain on the following Sunday, resulted in damage estimated by the City of Shaker Heights, at $250,000 to city property and damage in millions of dollars to private property. Flooding along Kingsbury Run and Tributary 2 of Kingsbury Run occurs due to hydraulic overloading of storm drains causing overland flow.

2.4 Flood Protection Measures

The City of Shaker Heights has no structural flood protection measures. Nonstructural measures of flood protection are being utilized to aid in the prevention of future flood damage. These are in the form of land use regulations adopted from the Code of Federal Regulations which control building within areas that have a high risk of flooding.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

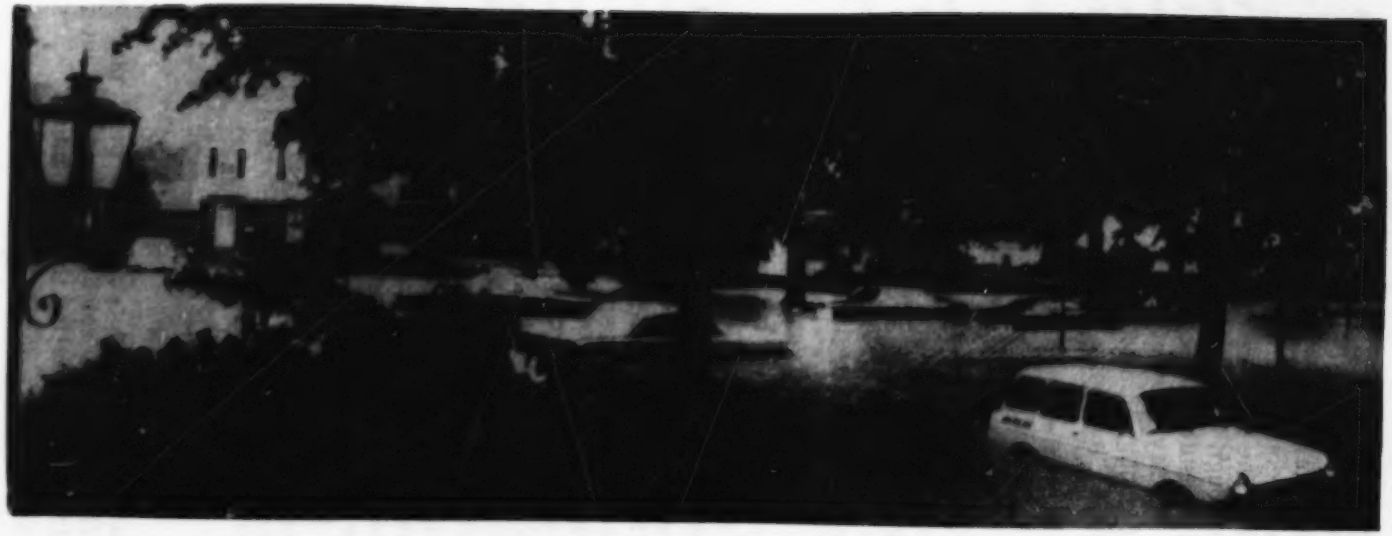

Figure 2 - Flood of August 24, 1975, looking south from Lytle Road into Scottsdale Boulevard.

There are no recorded streamflow data for the detailed study reach of Doan Brook through Shaker Heights. The 10-, 50-, and 100-year frequency events for Doan Brook were initially determined from estimating equations involving drainage area, slope of main channel, and lake storage as developed by the USGS and presented in Bulletin No. 45 (Reference 6). The 500-year frequency discharges were determined from extrapolation of the referenced estimating equations.

To account for urbanization in the drainage area, the preliminary frequency discharges for Doan Brook were adjusted using equations developed by the USGS for urban areas in Oklahoma (Reference 7). These equations were modified for the study area based on rainfall frequency data for the Cleveland area (Reference 5).

The general retarding effects of lakes and ponds within the drainage area of the detailed study reach are reflected by the estimating equations of Bulletin No. 45. The only exception to this procedure was on Lower Shaker Lake. Reductions in the downstream peak urbanized discharges due to uncontrolled storage in this lake were computed from a relationship of inflow-storage-outflow (Reference 8). The effect of Shaker Lake on downstream peak discharges is indicated in the Summary of Discharges, Table 1.

The City of Shaker Heights provided discharge information in regard to possible Shaker Boulevard bridge modification. A frequency discharge comparison with our data was in agreement, but the city used a higher urbanization factor and a smaller drainage area. Therefore, the drainage areas were modified to accurately reflect the effective drainage area.

Flood frequency discharges on Doan Brook had previously been determined at a location approximately 1,100 feet downstream of the study area for the City of Cleveland Flood Insurance Study (Reference 9). A discharge-frequency area comparison with that data indicated the frequency discharges determined on Doan Brook for this study are appropriate for use.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of the flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA* (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
DOAN BROOK					
Downstream study limit	5.1	1,220	1,860	2,210	2,950
Downstream Lower Shaker Lake	4.7	1,160	1,770	2,100	2,810
Upstream Lower Shaker Lake	4.7	1,875	2,600	3,000	3,800
Downstream Tributary 1	4.0	1,685	2,290	2,695	3,370
Upstream Tributary 1	2.4	1,365	1,865	2,195	2,775
Upstream study limit	0.5	415	575	675	860

*Effective drainage area contributing to the peak discharge

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along the flooding source studied in detail.

Cross sections for the backwater analyses of Doan Brook were obtained from orthophoto topographic maps at a scale of 1:2400, with a contour interval of two feet (Reference 10). The below-water sections were obtained by field measurements. All bridges, dams, and culverts were field checked to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n"), used in the hydraulic computations, were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Roughness values for the main channel of Doan Brook range from 0.03 to 0.045, with flood plain roughness values ranging from 0.04 to 0.12 for all floods.

Starting water-surface elevations for Doan Brook were provided from the City of Cleveland Flood Insurance Study (Reference 9). Water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program

(Reference 11). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Divided flow occurs just downstream of lower Shaker Lake. In this area the flood waters flow in the spillway just north of the corporate limits and in the main channel of Doan Brook to rejoin at a point about 300 feet downstream of the Moreland Boulevard Bridge over Doan Brook.

The volume of flow in the spillway was determined using the broad crested weir formula (Reference 12).

The volume of flow in the main channel of Doan Brook just downstream of lower Shaker Lake was determined using the broad crested weir formula and orifice flow calculations (Reference 12). The broad crested weir coefficient was determined using unpublished general weir rating curves developed by the COE.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:2400, with a contour interval of two feet (Reference 10).

The spillway just downstream of Lower Shaker Lake was studied approximately. The boundary of the 100-year flood was developed using the elevation of Doan Brook where it is joined by the spillway, and delineated using the above-referenced maps.

For the streams studied by approximate methods, the boundary of the 100-year flood was developed from the Flood Hazard Boundary Map (Reference 13), and delineated using the topographic maps referenced above. Knowledge of areas of past flooding on Kingsbury Run and Tributary 2 of Kingsbury Run was the main source for determining the boundaries of the approximate flooding in these areas.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

No floodway was determined for Doan Brook since no further development is being planned for the flood plain. Land use regulations currently prohibit further development in this area.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 3.

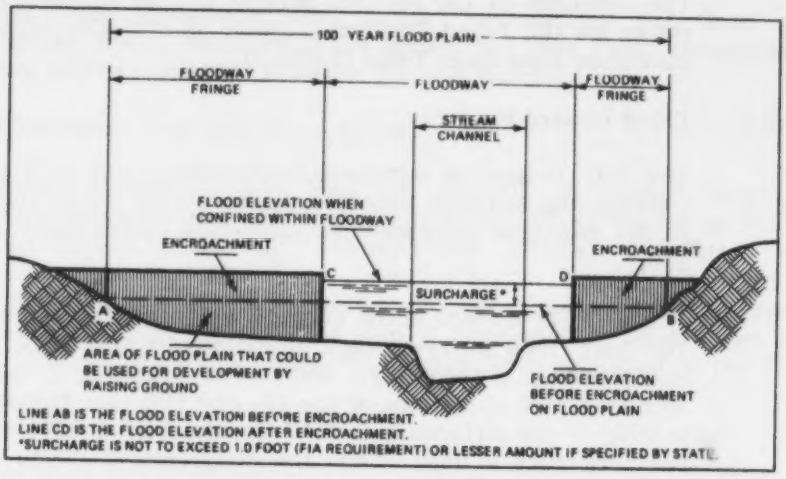
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 3 - Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the City of Shaker Heights.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the City of Shaker Heights are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 2).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Shaker Heights was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zones A2, A6:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 2, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Shaker Heights is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

This study has been prepared concurrently with the Flood Insurance Study for the City of Warrensville Heights (Reference 14). It has also been coordinated with studies for the Cities of Cleveland, Beachwood, Cleveland Heights, and University Heights (References 9, 15, 16, and 17). These studies are in agreement with this study.

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 13). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
DOAN BROOK							
REACH 1	0003	–1.2	–0.4	0.7	010	A2	VARIES–SEE MAP
REACH 2	0003	–2.9	–0.9	2.3	030	A6	VARIES–SEE MAP
REACH 3	0003,0004	–0.9	–0.3	0.5	010	A2	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF SHAKER HEIGHTS, OH
(CUYAHOGA CO.)

FLOOD INSURANCE ZONE DATA

DOAN BROOK

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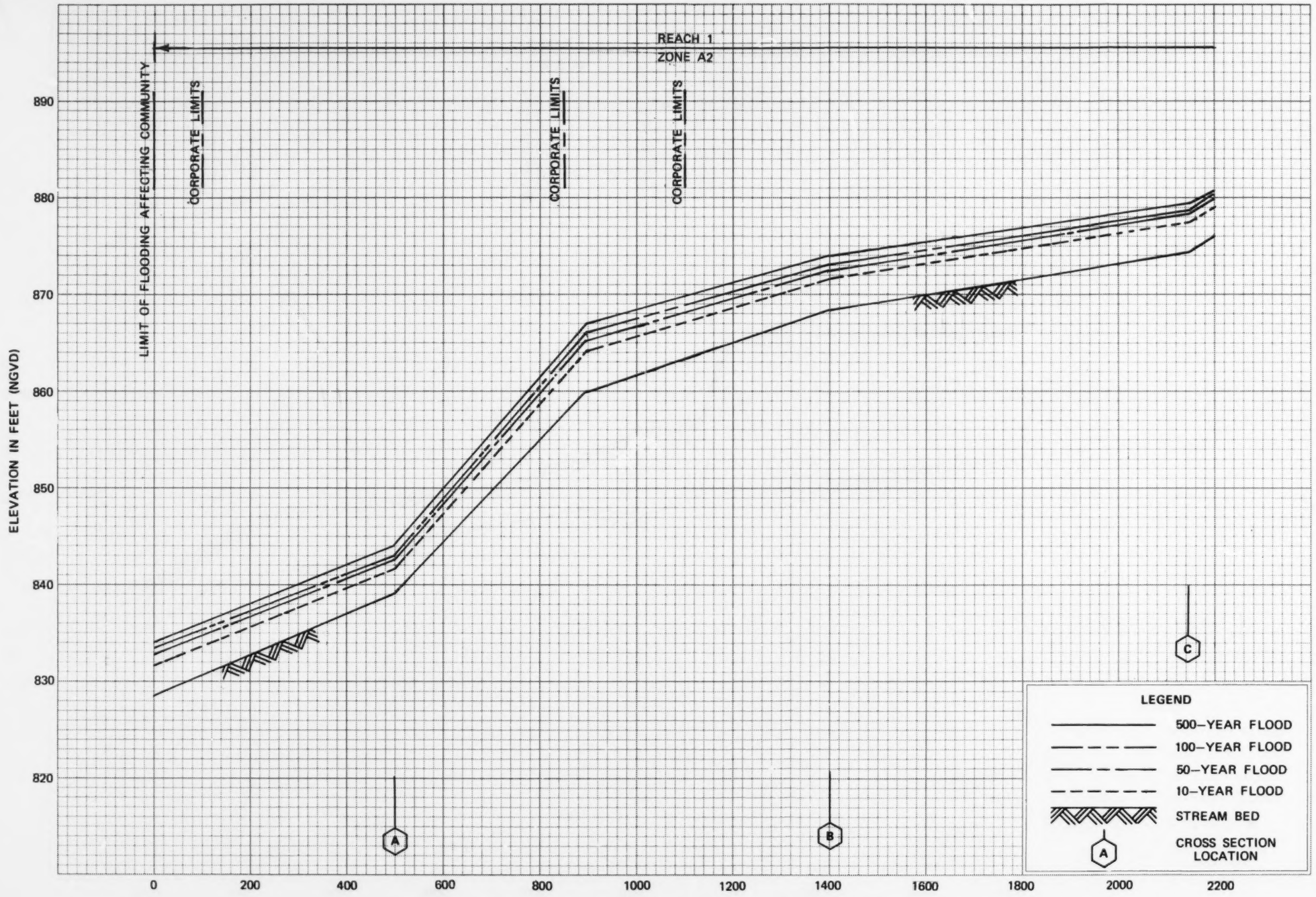
14. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Warrensville Heights, Ohio, (in progress).

15. ----------, Flood Insurance Study, City of Beachwood, Ohio, (in progress).

16. ----------, Flood Insurance Study, City of Cleveland Heights, Ohio, (in progress).

17. ----------, Flood Insurance Study, City of University Heights, Ohio, (in progress).



FLOOD PROFILES

DOAN BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF SHAKER HEIGHTS, OH
(CUYAHOGA CO.)

01P

REACH 1
ZONE A2

FAIRHILL ROAD
COVENTRY ROAD
FOOTBRIDGE
UNNAMED ROAD
DAM

ELEVATION IN FEET (NGVD)

910
900
890
880
870

D E F G H

2200 2400 2600 2800 3000 3200 3400 3600 3800 4000

STREAM DISTANCE IN FEET ABOVE LIMIT OF FLOODING AFFECTING COMMUNITY
(LIMIT OF FLOODING AFFECTING COMMUNITY IS 100 FEET DOWNSTREAM OF CORPORATE LIMITS)

LEGEND

- 500–YEAR FLOOD
- 100–YEAR FLOOD
- 50–YEAR FLOOD
- 10–YEAR FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

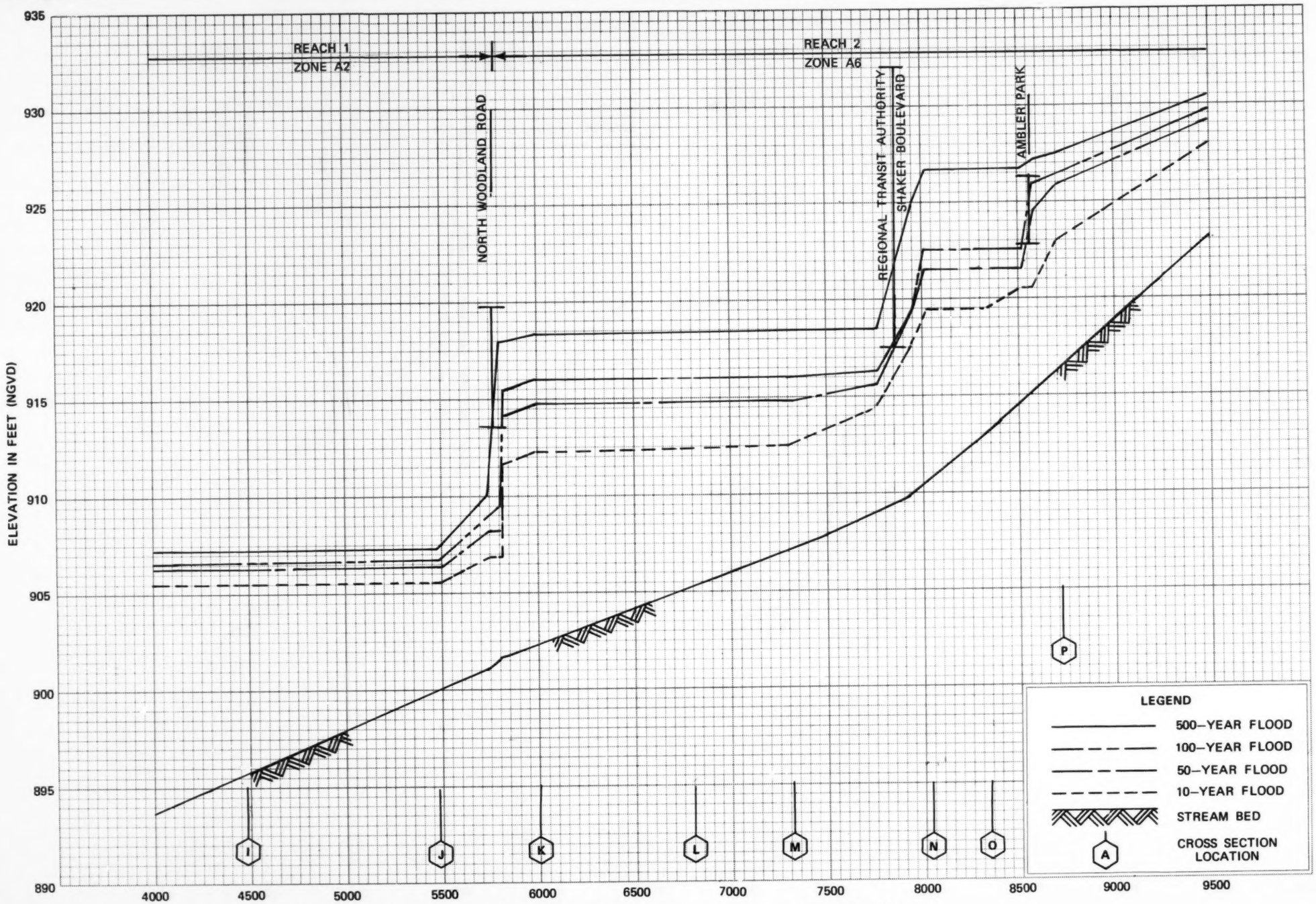
FLOOD PROFILES

DOAN BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF SHAKER HEIGHTS, OH
(CUYAHOGA CO.)

02P



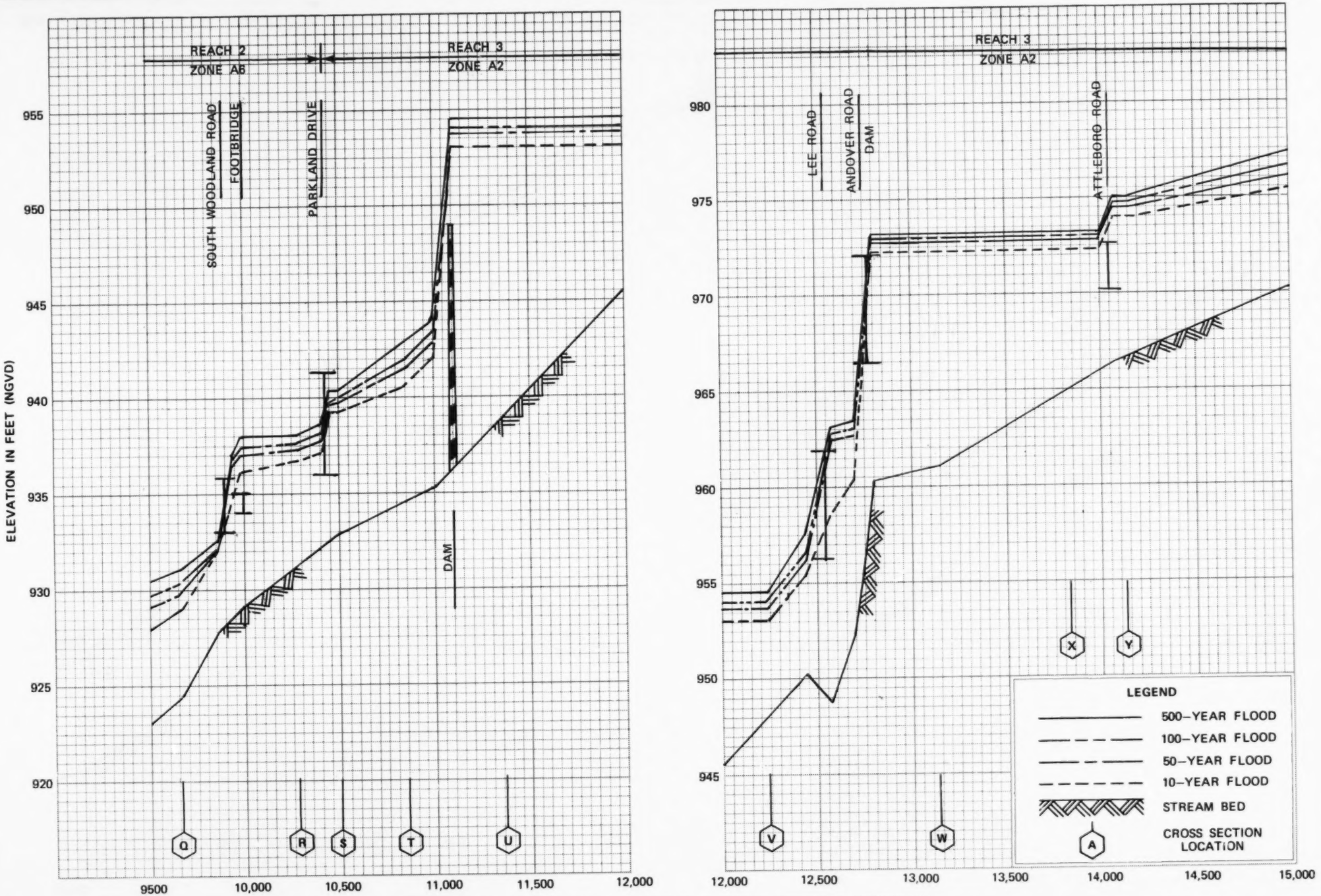
FLOOD PROFILES

DOAN BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF SHAKER HEIGHTS, OH
(CUYAHOGA CO.)

03P



STREAM DISTANCE IN FEET ABOVE LIMIT OF FLOODING AFFECTING COMMUNITY
(LIMIT OF FLOODING AFFECTING COMMUNITY IS 100 FEET DOWNSTREAM OF CORPORATE LIMITS)

FLOOD PROFILES

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(CUYAHOGA CO.)

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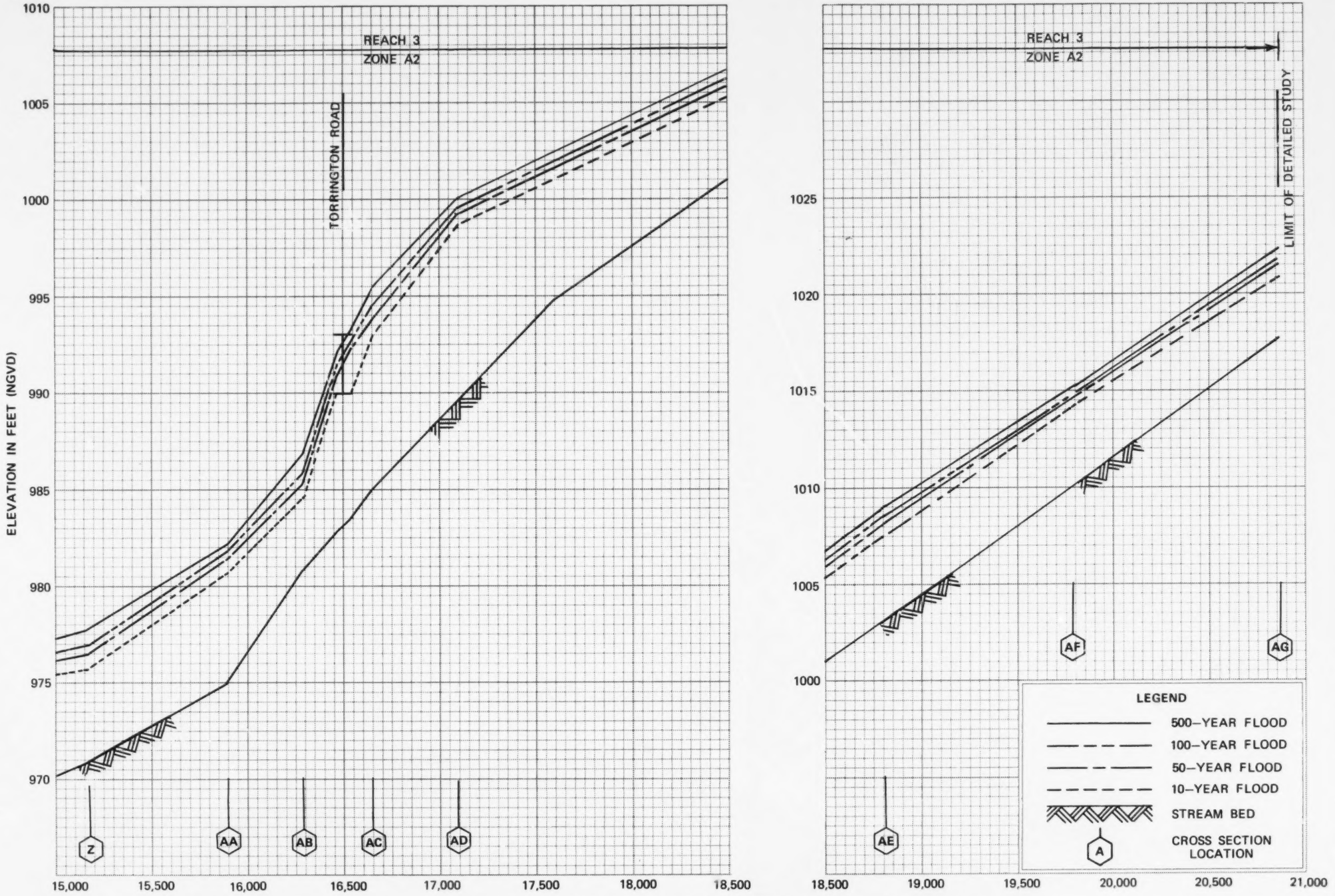

STREAM DISTANCE IN FEET ABOVE LIMIT OF FLOODING AFFECTING COMMUNITY
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